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2 **IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

3 **UTILITY PATENT APPLICATION**

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5 INVENTOR: Darrell W Kelsoe

6 TITLE: Process For Treating Wood And Products From Treated Wood

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8 PREPARED BY: Gregory M. Friedlander

9 **GREGORY M. FRIEDLANDER & ASSOCIATES, P.C.**

10 Attorneys at Law

11 11 South Florida Street

12 Mobile, Alabama 36606-1934

13 Phone (334) 470-0303

14 Fax (334) 470-0305

15 E-Mail: [Isee3@aol.com](mailto:Isee3@aol.com)

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17 **PRIORITY**

18 This patent is a continuation in part of Provisional Patent 60/213,198 filed June 21<sup>st</sup>, 2000

19 and Utility Patent Application 09/788,165 filed February 15, 2001.

20 **PRIOR ART**

21 The prior art consists of various chemical and dry kiln loading and unloading techniques  
22 for wood. Silicon treatments are not unknown, but actual modification of the cellulose to  
23 incorporate a silicon shield is unknown.

24 Scientists and researches have been seeking an effective silicon based wood treatment for  
25 decades. Studies have suggested that silicon is effective in the treatment of wood. Difficulties  
26 have arisen, however, in how to effectively carry the silicon into the wood and keep it there.

1 Studies performed by leading researchers in the United States and Europe have noted that the  
2 water repellent effects of silicon are often outweighed by the swelling of the wood. Tests  
3 comparing the effectiveness of wax resins and silicon have noted concretely that silicon based  
4 treatments provide statistically significant benefits.

5 In addition to the benefits of silicon are the well documented benefits of boron. Boron  
6 compounds are well known insect repellents and they are widely used in the treatment of wood  
7 products, primarily oriented strand board (OSB) and other manufactured wood products  
8 (especially, those that are used in residential construction). The biggest drawback of the use of  
9 boron in the treatment of wood is that it leeches out of the wood too quickly. This leaching has  
10 the obvious detrimental effect of leaving the treated wood in an un-treated state after a relatively  
11 short period of time.

12 Current wood treating techniques require that the wood be dried prior to the treatment  
13 process. This makes sense when viewed in relation to the previously discussed method of carrying  
14 the treatment to the wood with prior chemical treatments, if the wood is naturally "wet" (or  
15 green) the carrier is less efficiently absorbed and cannot effectively distribute the treatment  
16 chemical. Accordingly, wood is dried in one of several, expensive ways. Larger wood pieces (i.e.  
17 railroad ties, utility poles, timbers, etc.) are typically "air dried". This process requires that the  
18 wood be stored in vast lots where they will naturally dry due to their exposure to the elements.  
19 In addition to the costly management, there is the "hidden" cost of inventory. Most wood that is  
20 air dried is required to sit idle on a lot for 6-12 months. The financial burden of having to carry  
21 these enormous inventories of dormant wood has been estimated at nearly \$100 million annually  
22 for the railroad industry alone.

1       The other common drying technique is kiln drying. This is a significantly faster process  
2   but the expense involved in the construction of the drying buildings and the energy utilized to force  
3   the wood dry can be as expensive as air drying.

4   GENERAL DISCUSSION OF THE INVENTION

5       The Wet Preservation Chemical Treatment, hereinafter "WPTC", is a chemical. "WPTC"  
6   or the Chemical has been specifically created for use in treating wood and wood products. The  
7   Chemical is preferably comprised of non-toxic and environmentally safe components which react  
8   with molecules of wood. When the Chemical comes in contact with wood a reaction occurs which  
9   causes a molecular change in the wood itself improving the wood's strength and durability while  
10   simultaneously rendering the wood impervious to water, fire, rot, fungus, insets and many other  
11   environmental factors.

12       "WPTC" is a solution that contains, silicon and boron in the preferred embodiment. These  
13   two chemicals have been proven effective in the treatment of wood and wood products. There  
14   has been no way to have the chemicals remain in the wood for extended periods of time or to  
15   control the release of one with the other. With "WPTC" at least one of these two chemicals are  
16   absorbed into and become part of the wood. Chemical equivalents may also be used.

17       Existing wood treatment methods require that a chemical be carried into the wood to  
18   create the desired results. The treatment methods most commonly used today utilize oil (in the  
19   case of creosote) or water (in the case of Chromated Copper Arsenate (CCA)) as the carrier to  
20   deliver chemical into the wood. These carriers are used to force chemicals inside of the wood to  
21   treat the wood. There is little or no chemical action or reaction with the wood itself. Any such  
22   reaction is incidental.

1       Several factors can result in differing levels of benefit to the treated wood using these  
2   current methods including:

- 3             •       The amount of the chemical in relation to the carrier (i.e. how diluted is the  
4                      mixture);  
5             •       The amount of pressure exerted on the chemicals to “force” it into the  
6                      wood; and  
7             •       The amount of time the wood remains under pressure.

8       These primary variables can be adjusted to produce different “grades” of treated wood for  
9   different end products. For example, a piece of dimensional lumber will not normally be as  
10   thoroughly treated as a pole that will be submerged under water. A railroad cross tie which will  
11   be in direct contact with the ground can be “treated” more than wood used in common decking.  
12   Typically, the higher the concentration of chemical to its carrier and the longer the treating time  
13   the higher the overall cost of treatment.

14       Water and oil carriers are lacking. While they carry the chemical into the wood they also  
15   are carried into, and remain in, the wood itself. A standard cubic foot of untreated wood will  
16   absorb as much as 3.5 gallons of water or oil during a normal treatment process. Regardless of  
17   how much treating chemical is carried into the wood, the water or oil remain adding weight and  
18   no treating value. They may even serve to carry out some of the treatment.

19       The carrier for “WPTC” works with the molecule of the wood itself “WPTC” is not  
20   carried into the wood but rather is drawn into the wood through a reaction with the molecules of  
21   the wood. The chemical reacts with the molecules of the wood to force an expulsion of the water  
22   and other liquids inside the wood and the creation, through the Chemical’s molecular reaction, of

1 a tough, highly resistant polymer shield. Because the wood draws “WPTC” into the wood itself  
2 there is no need to use high-pressure to treat the wood. This is a drastic departure from the  
3 century old process of utilizing high pressure to force various chemical and treating compounds  
4 into the wood

5 Treating wood has required that the wood be “dried” prior to treatment. Cut timber needs  
6 to be kiln or air dried to a level of approximately 14-20% moisture level prior to treatment with  
7 existing technologies. This process is costly in terms of time (air drying) or money (kiln drying)  
8 and adds a significant cost to the overall treated product. The drying process is necessary since  
9 the agent used to carry the treating chemical(s) into the wood needs room to travel. A “green”  
10 piece of wood will not allow a prior art treatment carrier to enter to an acceptable level. It is  
11 somewhat akin to a wet sponge. When it is very wet it will not absorb any more moisture. It  
12 needs to be dried to a certain degree to allow more liquid to penetrate its surface.

13 Because “WPTC” is drawn into the wood through a molecular reaction, it actually works  
14 faster on a “green” piece of wood. This is due to the fact that the chemical reaction of “WPTC”  
15 is accelerated by the reaction or mixture with water and other natural liquids inside a piece of  
16 wood. This acceleration pulls the Chemical into the wood, causes a molecular reaction and may  
17 expulse the excess water and other liquids originally contained within the wood. It can act as a  
18 combination treatment and drying process in one step. In the wet sponge example above,  
19 “WPTC” is drawn into the wet sponge and the original liquid is a carrier and may be replaced to  
20 some extent.

21 When the reaction with “WPTC” is complete water and other liquids are less able to enter  
22 the wood. With the molecular change in the wood’s natural liquids and the creation of a

1 protective polymer, the wood is naturally and permanently, protected from water; rot; insects;  
2 decay, etc.

3 Tests show that wood treated with “WPTC” in it’s preferred embodiment is:

4 Waterproof

5 Decay Resistant

6 Insect Resistant

7 Stronger than before treatment

8

9 “WPTC” has been able to incorporate all of the benefits attributed to both silicon and  
10 boron and lock those benefits within the molecules of the wood. By using the natural liquids of  
11 the wood to literally “pull” the chemical into the wood while simultaneously reacting with these  
12 liquids, “WPTC” replaces the molecules of these liquids with the molecules of boron and silicon  
13 and ingeniously creates a polymer “shield” to encapsulate the solids thereby providing an  
14 unprecedented level of protection to the wood.

15 The result is a wood product that is nearly “petrified” in its defense against water, rot,  
16 insects and other ailments common to wood. Water literally “beads” on top of wood treated with  
17 “WPTC” due to this shield. Rot is hindered since it requires moisture to thrive. Insects and  
18 fungus cannot thrive because of the lack of moisture, the presence of boron compounds, and their  
19 inability to penetrate the polymer shield.

20 This same treatment works on aftermarket wood products (paper product and wood composites).

21 While current treatment processes require an additional chemical and treatment process  
22 to provide a minimal level of fire retardant, “WPTC” can be enhanced to create its own, natural

1 fire retardant through the polymer and boron shield. This enhancement does not require any  
2 additional conventional equipment and can be completed as part of the chemical process.

3 Existing treatment processes require that different wood products be treated at different  
4 levels depending on the specifications of the end use of the wood product. These different levels  
5 are primarily measured in pounds of solid chemicals per cubic foot of wood. In this manner a  
6 wood product used above ground will have less chemical via the treatment process than one  
7 intended as a permanent wood foundation.

8 "WPTC" is environmentally friendly. On the environmental front, many within the  
9 industry recognize an obligation to protect the environment while simultaneously understanding  
10 that the economic advantages of a clean treatment can provide significant benefits in this ever  
11 increasingly regulated industry. In addition to the environmental component, the inability of the  
12 treating industry to penetrate more than 10% (+/-) of the wood industry due to the severe  
13 limitations of the current treating processes has created a desire to discover new methods of  
14 treating that will provide the benefits required of the balance of the industry.

15 "WPTC" allows wood to be treated without altering the shape of the wood or causing  
16 swelling. The chemical can also be used as an after-market treatment product. The after market  
17 product will be slightly different than the commercial product, typically in its level of strength.  
18 This is important since many existing structures and wood products can receive the benefits of  
19 "WPTC" even though they are already "in place". Anticipated after-market examples include the  
20 treating of wood frame houses to control termite and/other bug infestation; the treatment of  
21 previously installed railroad ties; utility poles; decking, etc. such that they receive the benefits of  
22 "WPTC"

1        There is also a segment of the wood industry, that is part of the nearly 90 billion board feet  
2    that currently is not treated or is treated in an ineffective manner. The benefits of man-made wood  
3    are accelerating and the need for better, and more efficient wood keeps growing. Wood used in  
4    specific market segments such as the construction of mobile homes, wood decking in tractor  
5    trailers, wood flooring in railroad cars, shipbuilding and others, not to mention residential home-  
6    building, wood flooring in railroad cars, shipbuilding; and others, not to mention residential home-  
7    building; will all benefit significantly from a wood treatment that would render the wood  
8    waterproof, fire retardant; insect resistant and decay resistant.

9        Another use for "WPTC" is in the manufactured wood segment of the market.  
10      Manufactured wood is comprised primarily of Oriented Strand Board (OSB) and Particle board.

11      The primary benefits to users of manufactured wood is that it is more economic to manufacture  
12    and is more adaptable to different uses since it can be shaped by machine. OSB can be formed in  
13    almost any shape. Manufactured wood is actually stronger than natural wood because of the way  
14    in which it is manufactured. Yet it is more economical because it uses small pieces (strands) of  
15    wood rather than relying on large, natural boards.

16        There are two significant drawbacks to manufactured wood, however. First is its level as  
17    a fire retardant. While acceptable for many uses it does not have a high enough level to be used  
18    in as many places as it could. Second is its unfortunate characteristic of swelling when it comes in  
19    contact with water

20        Using "WPTC" as a treatment for the raw material used in manufactured wood would  
21    solve these two problems. The level as a fire retardant would increase sufficiently to expand the  
22    market for these man-made woods even more so than they have to date.

1       “WPTC” reacts molecularly with the natural components inside of wood. The end result  
2   is a dry piece of woods that has superior resistance to water, fire, rot, insects, etc.

3       Current treatment processes use oil, water or other carriers to transport treating chemical  
4   into the wood. A significant portion of these carriers remain in the wood often causing swelling  
5   and/or warping of the wood. “WPTC” causes no such alterations.

6       Unlike current treatment processes, wood treated with “WPTC” does not gain significant  
7   weight. This is due to its unique nature of using the liquids within the wood as the agent to carry  
8   the chemical into the wood. Current treatments use oil, water or other carriers to transport  
9   chemicals into the wood. These carriers themselves remain in the wood adding as much as 25  
10   pounds to every cubic foot of treated wood. Wood treated with “WPTC” has an almost even  
11   exchange (on a weight basis) with the weight of the natural liquids traded for the weight. This  
12   lack of weight gain is a critical cost advantage since transportation is one of the larger cost  
13   components of treating wood. Lighter wood means less cost.

14       Whether treated after the manufacturing process or by treating the wood components prior  
15   to manufacture, “WPTC” is an excellent treatment for these man-made wood products.

16       Care should always be taken when handling any chemical and such is the case with  
17   “WPTC”. The chemical itself reacts very strongly with liquids. The chemical reaction may also  
18   produce a harmful discharge, such as HCL. One step in the process would be to neutralize the gas  
19   to environmentally safe compounds or modify the reagents used to effect this end.

20       Because wood treated with “WPTC” goes through a chemical change, the treatment alters  
21   the molecules of the wood to create a new molecule holding the silicon and the boron compounds  
22   within a polymer shield. The level of leaching of the chemical may be controlled due to the fact

1 that it is encapsulated within the wood itself to different degrees based on treatment techniques.

2        Though the molecular change that occurs in the treatment process changes some of the  
3 molecular components of the wood, it does not change the structural character of the wood  
4 detrimentally. It hardens the wood through the creation of the polymer shield. This polymer  
5 component acts like a kind of plastic. Depending on formulation it may increase or decrease the  
6 flexibility of the wood while strengthening the wood.

7        All wood can be treated with "WPTC". Hardwoods, softwoods and man-made woods  
8 accept the treatment process. In current treating process there are different treatment levels,  
9 treating times and/or chemical dilution levels.

10       One variation for "WPTC" is the level of liquid within the wood being treated (i.e. "green"  
11 vs. "dried"). Less liquid in the wood requires slightly more time and pressure than wood with a  
12 higher level of liquid.

13       Because of the molecular change in the wood, the elimination of the wood's liquids and  
14 the creation of a polymer shield, wood treated with "WPTC" is especially well suited for in-ground  
15 and/or underwater use. Neither the salt nor the water can penetrate the wood as well to cause any  
16 damage.

17 by wood treating companies to produce environmentally safe, treated wood and wood products.

18       Wood treating today follows a long and expensive path that ultimately produces a useable  
19 wood product. The path a standard 2" x 4" x 8" pine stud would follow from forest to market in  
20 the treating process currently in use as compared to the process required with "WPTC" is shown  
21 below. It can be readily seen that the overall treatment process utilizing "WPTC" is significantly  
22 faster and more economical than current treating processes.

1        Current treating processes necessitate that the wood absorb a great deal of the chemical  
2    and the carrier (i.e. water or oil) which significantly increases the weight of the wood. A cubic  
3    foot of wood will hold nearly four gallons of water which can increase its weight by over 25  
4    pounds. When wood is treated with "WPTC", the liquids in the wood may be removed. When  
5    compared to existing treating methods, "WPTC" results in significantly lighter finished products  
6    thereby reducing transportation expenses.

7        Another benefit of "WPTC" is the handling of the treated wood. Wood treated with  
8    Creosote must be handled very carefully as the chemical is toxic. Railroad workers, utility pole  
9    workers and other who handle creosote treated wood register complaints of swelling hands, sores  
10   and blisters from coming in contact with the chemical. "WPTC" is safe and can be handled  
11   without gloves or other protective equipment after it has been treated.

12       Still another benefit, though certainly not the last, pertains to the disposition of treated  
13   wood. Though claimed to be environmentally clean, wood treated with Creosote or CCA must  
14   be disposed according to very specific guidelines so as not to harm the environment. There are  
15   no such regulations expected for "WPTC".

16       **CURRENT TREATING METHOD**

- 17        (a)     A tree is felled and hauled to a sawmill;
- 18        (b)     The tree is milled into rough wood pieces slightly larger than the finished product;
- 19        (c)     The rough wood is kiln dried so as to remove up to 85% of the moisture content  
20              of the "green" wood;
- 21        (d)     The rough, dried board is milled again to trim it to its finished size;
- 22        (e)     The rough, dried board is treated by immersion into a highly pressurized (120 psi)

- 1 cylinder filled with a mixture of water and a treatment chemical ("CCA"). The  
2 treating process typically lasts from 15 - 45 minutes;
- 3 (f) A 2" x 4" x 8" pine stud contains approximately 4.5 board feet of wood. The stud  
4 will typically absorb about 1.3 gallons (approximately 10 pounds) of liquid  
5 (chemical and carrier) as a result of the treat process;
- 6 (g) The cylinder is drained of chemicals and a vacuum is created within the cylinder  
7 remove excess chemical from the wood and the boards are removed;
- 8 (h) The treated board is sent to be kiln-dried;
- 9 (i) The dried, treated, finished board is shipped.

10 "WPTC" TREATING METHOD

- 11 (a) SAME
- 12 (b) SAME
- 13 (c) NOT REQUIRED
- 14 (d) The rough, "green" wood is milled again to trim it to its finished size.
- 15 (e) The board is treated by immersion into a slightly pressurized (15 psi) cylinder  
16 filled only with "WPTC". The treating process requires 5-10 minutes;
- 17 (f) Due to the molecular reaction of "WPTC" and the wood's natural liquids, the  
18 wood expels liquid while absorbing sodium silicate and borax. The treated wood  
19 weighs approximately as much after treatment as before;
- 20 (g) The cylinder is drained of chemicals and the boards are removed;
- 21 (h) NOT REQUIRED
- 22 (i) Since no liquid was absorbed by the wood treated with "WPTC", the treated stud

1 weighs only as much as it did prior to treatment approximately twice as many studs  
2 can be loaded on a single truck cutting transportation costs.

3 **SUMMARY OF UNIQUE PROPERTIES OF "WPTC":**

4 WPTC reacts with the molecules and natural liquids of wood to draw in the chemical.

5 WPTC does not require high pressure, to force chemical into wood.

6 WPTC is able to treat green wood as well as dried wood.

7 WPTC treated wood is environmentally clean.

8 Since it becomes "part of" the wood itself the chemical does not leach out of the wood  
9 into the environment

10 WPTC can be used (in a modified form) as an after-market treatment of existing wood.

11 Since no carrier is introduced into the wood WPTC does not cause swelling of the wood.

12 WPTC can be used in the treatment of OSB and other man-made wood products.

13 WPTC may introduce Borax and Sodium Silicate into the wood molecules thereby  
14 providing significant water, fire, rot and insect protection.

15 These and other objects and advantages of the invention will become better understood

16 hereinafter from a consideration of the specification with reference to the accompanying drawings

17 forming part thereof, and in which like numerals correspond to parts throughout the several

18 views of the invention

19 **BRIEF DESCRIPTION OF DRAWINGS**

20 For a further understanding of the nature and objects of the present invention, reference

21 should be made to the following detailed description taken in conjunction with the accompanying

22 drawings in which like parts are given like reference numerals and wherein:

1       Figure 1A, 1B, and 1C are alternate views of the structure of the cellulose of wood.

2       Figure 2 is a view of a chemical process for altering the cellulose structure of wood

3       showing one method of altering the structure of a single strand of cellulose.

4       Figure 3 shows a generic representation of the formula shown in Figure 2.

5       Figure 4 shows one alternate structural cellulose target.

6       Figure 5 shows an alternative target for the structure of treated wood.

7       Figure 6 shows a representation of cellulose.

8       Figure 6a show one theoretical model for products by the process taught herein.

9       Figure 6b shows what the inventor thinks is the more likely product generated by the

10      process taught herein.

11      Figure 7 (a-c) shows the most likely reaction with a silicon donor.

12      Figure 8A-D shows an alternate embodiment of the invention. Figure 8(B1) and (B2)

13      shows alternative intermediary boron molecules which may be generated in the process.

14      Figure 9 shows an alternative mechanism for achieving an alternative to intermediary 8b.

15      Figure 10 shows the production of an intermediary (b) and a possible reaction using both

16      boron and silicon (a) to guarantee a polymer with silicon and boron in the modified cellulose

17      structure (c).

18      Figure 11 shows a genuine representation of a reagent with cellulose (a). Here the reagent

19      is generically listed as R-Si - (X)<sub>3</sub>, where X is an O-R compound and R being an alkyl group;

20      halogen, or a hydroxyl group (OH).

21      Figure 12 shows a similar reaction to that shown in Figure 11 with a boron molecule

22      substituted for the silicon molecule Alternative embodiment are shown as B1 and B2 where two

1 hydroxyl groups on the cellulose which are replaced.

2 Figure 13 shows a block diagram of a process to treat wood.

3 Figure 14 shows a block diagram of a process to form particle board.

4 Figure 15 shows the process utilizing a catalyst.

5 Figure 16 shows an alternate embodiment of the process of claim 15 where the catalyst  
6 is acid.

7 **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT**

8 As can best be seen by reference to Figures 1A-1C Cellulose, the main cellular building  
9 block of wood, can be drawn as repeating series (n) of cellulose units having hydroxyl groups  
10 shown as 22 in Figure 1A and 6A (a modified cellulose molecule). Figures 1A-1C show the  
11 generally accepted ways of drawing the same structure in slightly different formats.

12 The present invention seeks to modify wood by modifying the hydroxyl groups of  
13 cellulose. This is, in the preferred embodiment, catalyzed by using an acid or by creating an acid  
14 during a reaction with the cellulose or water within the wood.

15 As can be seen by reference to Figure 2, one method of modifying the structure of the  
16 wood would be to introduce tri-methyl Chloro silane ( $\text{CH}_3)_3\text{SiCl}$  60 to the cellulose molecule to  
17 create a modified cellulose with the carbon silicate replacing the hydroxyl group and creating an  
18 acid which can further catalyze the reaction as discussed in more detail below. This basic  
19 structural replacement lies at the heart of one embodiment of the invention.

20 As can be seen by reference to Figure 3, and as discussed in more detail below, the  
21 representative molecule shown in Figure 2 is a derivative of hydroxyl replacement involving the  
22 use of any compounds reactive with the hydroxyl. What is relevant to the present invention is the

1 creation of a series of molecules from cellulose in preferably wet raw wood products and wood  
2 composite products. In Figure 3 a generic alkyl hydroxyl molecule 61 is reacted with a generic  
3 tri-alkyl halide silicate to yield (in the presence of water 64 from wood) a modified molecule 63  
4 which is more hydrophobic and acid 65 which acid 65 can act as a catalyst to continue the reaction  
5 as described in more detail below

6 Silicone or other reactants could easily in more violent reactions be found in other  
7 locations in the wood as shown in Figures 4 and 5, but these are more extreme examples and are  
8 less likely to occur within the framework envisioned in the disclosure taught herein and are shown  
9 only as potential by-products which are theoretically unlikely to occur given the disclosure herein.

10 Figure 6A shows a less likely structure for the molecular bonding where the cellulose in  
11 the preferred embodiment may contain, by exposure within the disclosure to silicone and boron  
12 reactant molecules and solutions, a limited replacement of the hydroxyl groups with boron and  
13 silicone becoming a part of the silicone chain. It is therefore one product which is claimed by the  
14 invention which is a cellulose chain modified to have bonded between hydroxyl oxygen atoms 23  
15 boron atoms 24, silicone atoms 25 or other hydrophobic or anti-degrading elements. As can be  
16 seen by reference to Figure 6A, these silicone atoms are preferably silicone atoms which have alkyl  
17 groups 26 attached to form alkyl silicates. It is taught that these alkyl groups may be varied  
18 according to the disclosure set forth below or may be replaced altogether.

19 As can best be seen by reference to Figure 6B, the expected end product involves the  
20 binding across the hydroxyl groups of the cellulose rings 37 of atoms or molecules (here boron  
21 or alkyl silicates) with the outer valence shells being competed across Oxygen molecules 40  
22 between the atoms or molecules. Figure 6B also shows how it is possible that the binding would

1 be less organized than that suggested in Figure 6a and that there may be binding across more than  
2 one hydroxyl group in a single cellulose molecule within a chain of repeating units (shown again  
3 in Figure 6c as n repeating units.

4 Figure 7 shows the suspected chemical process disclosed by the specification. In Figure  
5 7, methyl trichloro silane is used as a reactant or catalyst (as discussed in more detail below in  
6 reference to Figures 13 and 14). There are “n” molecules of the catalyst which react with “n”  
7 molecules of H<sub>2</sub>O present in the wood to yield “n” times 3 HCl molecules providing an acid  
8 environment for catalyzing the reaction of the silicate with the hydroxyl group. This reaction  
9 draws the reactants into the wood and allows for a greater penetration of the wood of the  
10 treatment. Aside from generating the acid environment, the silicate is converted to a hydroxyl  
11 form 30 (postulated) which forms a chain as shown at 32 which in proximity to the hydroxyl  
12 groups coming off of the cellulose ring units 34 reacts to form the silicate structure.

13 Figure 8 shows how boron may be introduced and trapped within a matrix formed within  
14 the preferred embodiment. The trapping of boron is particularly helpful since it may lead to insect  
15 resistance in the end product. In Figure 8 it can be seen that a boron compound 41 in the presence  
16 of water (from the wood) forms a boron hydroxyl molecule 42 which polymerizes much as the  
17 silicate in Figure 7 to form a boron hydroxyl chain 43 which in the presence of the cellulose binds  
18 to form chains 44 in the cellulose matrix. Alternate molecules shown as B1 and B2 may be formed  
19 as intermediary or final products which can be trapped in the matrix formed by the silicates shown  
20 in Figure 7 where boron and silicone products are used together or the matrix postulated as  
21 formed by the boron compounds as shown in Figure 8.

22 Figure 9 shows an alternate mechanism for the formulation of the boron chains 43.

1       Figure 10 shows a mechanism for the combination of silicates and boron molecules to form  
2   intermediary chains comprised of silicone and boron 50 which in proximity to cellulose 37 forms  
3   the modified combination cellulose and boron and silicone molecules 51 which are also those  
4   shown in Figure 6b.

5       Figure 11 shows an alternate mechanism for the combination of silicon reagents with  
6   cellulose. In Figure 11 it can be seen that the cellulose is placed in proximity (by way of a carrier  
7   solution of the type described in more detail below) with a group R'-Si(X)3 52 where R' is an  
8   alkyl or it's equivalent as discussed in more detail below and X is an OR group (R being a alkyl  
9   group from the same generic group as R') or a halogen or a hydroxyl group OH. This reaction  
10   shown in step B1 or B2 yields an intermediary 53 or 54 or both intermediaries. These then, in the  
11   presence of an acid or acid generated by the trimethyl chloro silane yields a more complex  
12   molecule where the silicate is combined along the carbon atoms of the cellulose as opposed to the  
13   hydroxyl groups as shown at B3.

14       Figure 12 shows the embodiment of Figure 12 where boron compounds 55 are substituted  
15   for the silicates of Figure 11 to yield the end products shown in steps B or C of Figure 12.

16       In order to allow for use of more common reactants, it is envisioned, as shown in Figures  
17   15 and 16, that a catalyst for the reaction could be provided by acids or molecules yielding acids.

18       In this preferred embodiment, the process includes the steps of:

- 19           1) Preparing a solution, preferably in alcohol (methanol or ethanol work well,
- 20           2) Adding a silicone donor wuch as a one to eight carbon alkyloxy group (methoxy,  
21           octyloxy, etc.)
- 22           3) Adding a strong acid (hydrochloric, phosphoric or sulfuric acid) directly or by way of

1           a catalyst yielding the acid in solution with the water in the wood such as methyl  
2           trichloro silane ( $\text{CH}_3\text{SiCl}_3$ ). In the preferred embodiment this is preferably an acid  
3           solution of .5%, but may range from 5% to .1%. It may also be outside this range with  
4           less certain results since the acidity of the wood is not desirable for most uses.

5           4) Exposing the solution prepared in steps 1-3 to cellulose to allow binding as shown  
6           with or without time and pressure restrictions to limit the extent of treatment.

7           The acid serves, when in contact with the water in the wood to yield ROH and  
8            $\text{RSi(OH)}_3$  compounds. The  $\text{RSi(OH)}_3$  reacts as discussed above with the cellulose to bind in place  
9           of one or more of the hydroxyl groups 22 of the cellulose to form the hydrophobic barrier.

10          The compound used as a reactant may be an alkoxy group having the formula R-  
11           $\text{Si(OCH}_3)_3$  (with the exact structure of the alkoxy part ( $\text{OCH}_3$ ) being subject to any variation  
12          within this group of chemicals which performs the desired function shown in the drawings or its  
13          equivalent. Free boron compounds in this formulation are expected to have peak efficiency under  
14          2% since the boron tend to counteract the hydrophobic properties of the silicates when the boron  
15          is not bound to the cellulose structure. This is an acceptable range since wood treatment generally  
16          desires .5% treatment with boron to be effective

17          Boron may be added as boric acid to the formula effectively in the range of .5 to 5% and  
18          is trapped in the silicone matrix. Alternatively, a reactive boron reagent of the type discussed  
19          above may be used to form a boron matrix such as that disclosed in Figure 10 when used in  
20          conjunction with a reactive silicate.

21          In this structure, the acid is in very low concentration (in the case of methyl trichloro silane  
22          approximately .5%) to the silicone main donor, in this case octyltrimethoxysilane (MTS) or it's

1 equivalent. This is significant for many reasons, not the least of which are the limitation of the  
2 acidity of the end products, the minimization of expensive reactants, the safety of the solution and  
3 the lack of toxic emissions

4 In one example, that of Figure 15, the formula is alkyltrialkoxysilane plus alcohol as the  
5 carrier plus an acid plus boric acid.

6 The second example (Figure 16) might employ the use of B(OCH<sub>3</sub>)<sub>3</sub> (trimethyl borane)  
7 at any percentage depending on the amount of boron desired. In this example the importance of  
8 another acid would be minimized or even eliminated

9 The acid catalyst could even be in the range of 0.01 to 10%. The 10% figure is pushing  
10 the reaction as a 10% additive would not be a catalyst but would be an environmental change. A  
11 base catalyst may also be employed, but is less effective within the same range. Examples are metal  
12 alkoxides [eg. sodium methoxide] Ammonia, Organic bases [eg. Triethylamine].

13 Methyltrichlorosilane (MTS) is not an acid catalyst. This could substituted with other  
14 alkylsilicone halides to generate the acid catalyst in situ in a range of 0.01-10%.

15 The present invention relates to the treatment of wood more particularly the invention  
16 relates to the treatment of wood in such a way that the chemical structure of all or part of the  
17 cellulose is altered to preserve the wood.

18 Cellulose has an average degree of polymerization, dependent on the source, typically  
19 between 3,500 and 12,000 although a lower degree of polymerization is found in wood pulp which  
20 has been treated

21 One of the primary ingredients in wood is cellulose which can be described as a chain of  
22 linked glucose units (Figure 1). Cellulose is generally a six carbon and one oxygen chain as shown

1 in Figure 1. There are repeating units (n) so that a consistent structure is indicated.

2 The primary way of dealing with wood treatment has historically been to cover the wood  
3 or insert some chemical in combination with the wood structure which would assist the wood by  
4 blocking the entry of elements or discourage insects from destroying the a basic cellulose  
5 structure.

6 The primary method disclosed herein would be to change cellulose and other chemicals  
7 within the wood so that all or part of these components are altered chemically.

8 As shown in Figure 2 one of the elements utilized in order to change the wood chemistry  
9 is silicon. In treating the wood in this manner, all of the wood or part of the wood may be so  
10 treated

11 Historically certain treatments have been taught in the treatment of cellulose but only after  
12 it is extracted from raw wood and the present invention seeks to improve on that by describing  
13 a method and a specific product which can be utilized and created in order to change the structure  
14 in native wood, chip wood derivatives, a living tree, in timber, poles or wood composites.

15 Broadly the patent can be described as the treatment of the wood with a reactive silicate  
16 donor which is preferably a carbon silicon halogen combination which replaces some of the  
17 molecules or atoms within the cellulose structure with silicon. Here, as shown in Figure 2 and 3,  
18 the hydroxyl (OH) group on some or all of one or more of the cellulose molecules is partially  
19 replaced with silicon. Many substitutions may be utilized in conjunction therewith, such as poly  
20 di methyl siloxane. A more complete list follows. Different diluents may be utilized and different  
21 chemicals may be added to change the degree of polymerization, the fire retardant features of the  
22 wood, to change the bug resistance, to change the water retention features and the like.

1        In the method shown in Figure 10, the wood is exposed to a solution of tetrahydrofuran  
2 (90%) having 1 percent borax as an insect repellant and 9% methyltrichlorosilane  $MCl_3Si$ ). As  
3 shown in Figure 10, the  $MCl_3Si$  and boron has hydrolized to produce  $MSi(OH)_3$  and  $B(OH)_3$ .

4        As shown in Figure 13, this solution may be enclosed with the wood. Heat from the  
5 reaction will add pressure which will increase the saturation. The release of pressure and heat will  
6 indicate a completed reaction.

7        Alternatively, the reaction time and pressure may be controlled so that less of the interior  
8 of the wood is affected to provide a surface treatment so that boron or other additives will be less  
9 completely trapped within the wood product.

10       A modified process of spraying or brushing may be utilized . This would be useful on  
11 existing structures or living trees where immersion could be problematic.

12       The alternatives shown in Figures 4 and 5 show less likely and more difficult products  
13 possible where molecules (X or Si) are used to join cellulose molecules in a different way or to  
14 provide stronger bonding. Also, there is the possibility of making silicon or other replacements  
15 in the cellulose ring in order to further derivatize cellulose and other reactive components of the  
16 wood

17       Specific embodiments taught herein use boron or other metallic or metalloid atoms such  
18 as boron, aluminum or a metal such as copper or compounds such as aluminum acetate containing  
19 those atoms that, in conjunction with a carrier, and preferably a reactive silicate of the type  
20 described herein provide additional protection within artificially fossilized wooden products.

21       In the embodiment of Figure 10 a metal carrier is utilized with methyl trichlorosilane to  
22 accomplish bonding between at least some of the cellulose molecules. When this chemical is

- 1 applied to wood under appropriate conditions it substitutes for some or all of the hydroxyl groups.
- 2 The reaction is enhanced by water within the wood.

3 Borax is an example of a boron salt which may be used in conjunction with the process.

4 The steps in processing the wood would be to prepare the solution, put the wood in  
5 solution and allow the combination of the wood and solution to be sealed so that the heat and  
6 pressure generated by the reaction, for example, between the methyl trichlorosilane could build.  
7 When the pressure drops, indicating that the heat generated by the reaction is ended or after a  
8 set period time if the wood is not to fully be treated, then the wood would be taken out of the  
9 solution

10 Alternatively the chemical compound described herein can be sprayed or brushed on the  
11 wood

12 One alternative step in this process described in the present invention is to utilize this  
13 technology in order to treat composite wood which has glues which favorably react with silicon  
14 in order to strengthen the bonding within the glue. It is noted that certain solvents will not affect  
15 certain glues and a proper combination of glue and solvent and silicate is necessary.

16 This can be found in what is commonly known as press board which utilizes a combining  
17 glue. The wood, even in these compressed and glued products, is treatable. The silicon may  
18 participate to strengthen the bonds in the glue where a proper combination is utilized.

19 Similar treatment can be accomplished with other components of wood such as lignin,  
20 carbohydrates and polysaccharides in order to accomplish similar results. Cellulose is preferred  
21 since it is such a prevalent part of the cell structure.

22 Other techniques disclosed in the present invention incorporates the use of ultrasound in

- 1 order to increase the ability of the wood to carry the reactive /fossilization compound of the type  
2 described herein or even when using a traditional treatment mechanism (Figure 13).

3 In order to incorporate Boron, Borax or Boron Anhydride may be used. In addition Boric  
4 Acid or trimethyl borate, a boron halide such as boron and fluorine or boron and chlorine in a salt  
5 can be used for different effects

6 THF (Tetrahydrofuran) alcohols, or acetone are exemplary solvents.

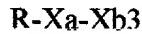
7 Silicon donors include methyltrichlorosilane, triethoxyoctylsilane, octeotrimethylsilane,  
8 clorotrimethylsilane and phenyl trichlorosilane.

9 The basic chemical process includes taking the silicon and/or boron donors (or their  
10 equivalents) with three water molecules from water in the wood. In the case of boron, that would  
11 yield boric acid plus water plus H<sub>2</sub>B<sub>4</sub>O<sub>7</sub> using of trimethyl borate or a different carbon borate.  
12 (Figures 7 and 8)

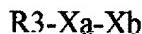
13 These would each react with one of the OH or hydroxyl groups of the cellulose.

14 The silicon would bond at the same location as the hydroxyl group. If boron and silicon  
15 are used together, a certain proportion of the hydroxyl groups would be replaced with the boron  
16 compound and a certain number will bond with a silicon compound and in some cases there could  
17 be an exchange.

18 The basic structure of the molecules used in the process described herein include:



20 or



22 R is a carbon compound, Xa is a trivalent, tetravalent or penta valent atom and Xb is a reactive

1 seven valence halogen (fluorine, chlorine, bromine, etc.) or their equivalent.

2 Hence, silicon donors might be shown with the general formula R-Si(X<sub>3</sub>) This silicon  
3 donor can be represented by the general formula where X is a halogen such as chlorine, bromine,  
4 iodine, or an alkoxy group (such as methoxy, ethoxy, propoxy, butoxy or an alkoxy group with  
5 the number of carbon ranging from 3 to 20 in a straight chain or a branched chain configuration.  
6 Larger chains cause interference problems with the reactions). The X may also be a phenoxy  
7 group, a benzyloxy group or an aryloxy group in which the aromatic ring is replaced with a  
8 polycyclic aromatic ring.

9 Silicon could be replaced with Ge, Tin or lead subject to environmental concerns and the  
10 qualities desired. For example, lead may be useful in the construction of nuclear plants.

11 The amount of the mixture of the boron and silicon donors with the solvent will determine  
12 the type and extent of bonding.

13 While boron and silicon are used to this example, titanium would work and so would many  
14 trivalent, tetravalent, or pentavalent atoms. In other words 3, 4 or 5 valence state atoms [and  
15 potentially molecules] would work in the bonding process. Examples of substitutes for boron  
16 include Aluminum, Gallium, Indium or thalium (Tl), by way of example.

17 **REAGENTS:** Boron and Silicon and related reagents include:

18 a) Boron oxide (B<sub>2</sub>O<sub>3</sub>) [Other metals having a 3, 4 or 5 valence outer shell could also  
19 function in this manner]. This chemical reacts with moisture and water within the wood or wood  
20 products to generate Boric Acid that could be entrapped within the silicon shield (when used as  
21 a mixture with silicon donors].

22 b) Chlorotrimethylsilane

- 1           c) phenyltrimethoxysilane
- 2           d) Triphenylsilylchloride
- 3           e) Propyltrichlorosilane
- 4           f) Propyltriethoxysilane
- 5           g) Hexamethyldisilanzane
- 6           h) Titanium tetrabutoxide [TBT]-an example of a tetravalent metal in place of silicon.
- 7           i) Triethylorthosilicate
- 8           j) OCTEO-S [n-octyltriethoxysilane, TECH];
- 9           k) Octyltriethoxysilane
- 10          l) trimethylborate [TMB]. This reagent reacts with water/mixture within wood to undergo
- 11         partial or full hydrolysis to polyborates or boric acid respectively. (See Figures 8, 9 and 10). It
- 12         could react after partial hydrolysis with methyltrihydroxysilane to form mixed boron and silicon
- 13         polymers as shown.
- 14          m) Tri-ethylborate is a reactive alternative which shows the use of an ethyl group in place
- 15         of a methyl group to produce a similar result with a larger carbon chain. Large carbon chains or
- 16         ring compounds may also be used as long as the carbon groups are not so large as to interfere with
- 17         the reaction.
- 18          n) Boron halides generally are workable, such as borontrichloride, borontribromide and
- 19         borontrifluoride. These are highly reactive compounds which directly react with the hydroxyl
- 20         groups of wood cellulose or other compounds of wood to form respective borates with the
- 21         elimination of acid halides
- 22          o) Boric acid: A 0.5 percent solution in acetone with an appropriate amount of TMB can

1 be used for a more stable formulation with a silicon donor such as MTS (Methyltrichlorosilane).

2 p) Methyltrichlorosilane [MTS]: This reagent in THF as a carrier is one of the initial  
3 formulations. Figure 7 shows the hydrolysis of MTS to methyltrihydroxysilane within the wood  
4 (postulated) and it's subsequent conversion to a polysiloxane that reacts with the hydroxyl groups  
5 of wood cellulose forming the polymer shield.

6 Figure 4 shows one alternative end product where one of the cellulose carbons is generally  
7 replaced with an atom, such as boron identified as X.

8 Figure 5 shows a second alternative end product where the oxygen connecting cellulose  
9 is replaced with silicon (or some other atom or molecule. While neither the embodiments shown  
10 in Figures 4 and 5 are considered likely products or intermediaries, they are disclosed as possible  
11 by products of a strong reaction.

12 If, in a reaction, hydrochloric acid is released it would preferably be diluted, degraded  
13 (neutralized), or otherwise removed during or after the treatment process to prevent the  
14 degradation of the wood or irritation caused by the slow release of this acid to the environment.

15 It could, for example, be converted to environmentally safe and natural salts.

16 This reaction might be shown as:

17 R-Si- X (here (CH<sub>3</sub>)-Si-Cl<sub>3</sub>) in a solvent to yield----R-Si - (OH)<sub>3</sub> (Step A) which would  
18 subsequently react with cellulose (Step B) to form the modified cellulose chain as shown in figure  
19 6 (Step C) plus water.

20 Diatomaceous earth, sodium silicates, or other boron or silicon salts may be used as a source  
21 of donor atoms. These may be mixed to provide intermediaries in solution which would, working  
22 together, carry out the desired end product in the wood. Examples of products having these

1 qualities include boric acid, trimethyl (trialkyl) borate, Boron Halides (BF<sub>3</sub>, BCl<sub>3</sub>, etc.), and Boric  
2 Anhydride (boron oxide).

3           **SOLVENT:** The solvent can vary tremendously also although it is preferably a non water  
4 based solvent so as not to cause a reaction or minimal water compound so it is not going to cause  
5 It would typically be structured so as not to effect the glue or other properties of wood  
6 composites.

7           1. (Acetone) is also a good carrier for non-glue wood composites.  
8           2. (THF (Tetrahydrofuran)) works well with glues used in wood.  
9           3. Poly dimethylsiloxane. May be used as an additive to boron compounds to result in the  
10           silicon and boron compounds.

11           4. Alcohols (Methanol or ethanol work particularly well).  
12           5. Water is also a solvent used in some cases. Water may be used with this formulation  
13           as an alternative to part of the organic solvents in certain formulations. Water may not work as  
14           well because it would compete with water in the wood unless a slower reaction was desired.

15           The various silicon-boron combinations, with or without the additives, will work on all  
16           wood and treated wood and wood products with varying efficiencies and compatibilities.  
17           Individual varieties in results may occur with the nature of the solvents used to prepare the formula  
18           and with the kind of sample of the wood to be treated. For example the acetone based formula  
19           may be optimal for soft wood, whereas the acetonitrile based formula may work better for hard  
20           wood. Likewise the non-acetone based formula may be the preferred embodiment for treatment  
21           of Particle Board, OSB or Chip Board where the glue is dissolved by acetone. The alcohol based  
22           formula may be better for southern pine and the like.

1           In some cases the solvent and additive may react in order to form a gel and in some cases  
2   it might be useful to agitate the solution in order to prevent that.

3           The proportion of chemicals results in different finishes and features and the solvents can  
4   also contribute to the variety of product out-comes.

5           Other solvents includes any water compatible organic solvents such as dioxain. One of the  
6   key elements of the solvents would be that it would have a boiling point under a 100 degrees  
7   Centigrade.

8           It is believed, but uncertain that borax and sodium silicate can be trapped inside a polymer  
9   shield formed by the reaction.

10          The current "WPTC" formula incorporating the carbon-silicon-halogen reagent, a boron  
11   donor, borax, sodium silicate, metal or metalloid catalysts or enhancers with THF or it's  
12   equivalents as the solvent.

13          The logical next step for "WPTC" is the expansion of specific carrier solvents, stabilizers  
14   and enhancers. An example of a chemical additive as an enhancer to retard fires are phosphorous  
15   compounds.

16          The purpose of the invention is generally to accelerate an alternative to fossilization of  
17   wood by providing an environment conducive to this. This works to crystalize or plastisize the  
18   wood. Copper compounds may be used in place of or in conjunction with silicon and boron within  
19   the process embodied herein.

20          **ENHANCING PROCESSES:**

21          Catalysts [Acids and products yielding acids in solution.] can be used to enhance the  
22   process as shown and described above in reference to Figures 15 and 16.

1       Another method of enhancing the process is to provide that it be done in an enclosure to  
2 allow the chemical reaction to build pressure. Pressure may be induced by external factors to the  
3 chemical reaction such as the use of ultrasound to speed up the process by aligning the molecules  
4 within the wood (whether cellulose, lignens or other molecules alone or in groups).

5       Other pre-treatment steps include the infusion of moisture in the wood before or during  
6 treatment. The use of wood closer to the production stage (i.e. greener wood) or putting other  
7 solvents to water within the wood prior to treatment with the chemicals in order to provide carrier  
8 chemicals within the wood can enhance the treatment. Water might be mixed with wood  
9 composites in order to help the process along.

10       Also donors (of boron or silicon for example) may be infused within the wood prior to the  
11 addition of the solvent or acid on silicate catalyst. This would be particularly simplified where  
12 wood composites (fiberboard for example) were being manufactured prior to being treated in the  
13 process steps.

14       The R group in the above silicon donor is an alkyl group ranging in a carbon chain length  
15 of 1-20 units in a straight chain or branched chain configuration. All these reagents are capable  
16 of undergoing the similar transformation as depicted in Figure-7, Figure-14 or Figure-15. The  
17 reaction, the non-halogen substituted silicon reagents in this general formula react only slowly and  
18 the completion of the reaction would require a longer time, under ordinary conditions. However  
19 this process could be enhanced by the inclusion of acid or base catalysts to the silicon reagents,  
20 as shown in Figures 14 and 15. These catalysts may include, but are not limited to, a metal  
21 alkoxide or an acid such as meta-phosphoric acid.

22       1)      Other hydrophobic Reagents: In the above general formula Silicon (Si) can be

1                         substituted with Titanium (Ti) and all other factors may remain the same. A  
2                         typical example would be Tetramethyltitanate. A general representation of the  
3                         formula would be Ti [R]<sub>4</sub> where R = a halogen, an alkoxy group, a phenoxy group  
4                         or a benzyloxy group as defined above for the silicon donor.

5        Other Wood Cellulose Modifying Reagents:

6                         The following silicon reagents can also react with the hydroxyl groups of wood  
7                         components to render wood hydrophobic and insect and fire resistant. :

8                         (1) Dichlorodimethylsilane represented by the general formula: [R]<sub>2</sub> Si (X)<sub>2</sub>; where R is  
9                         an alkyl group ranging in carbon chain length of 1-20 units as a straight chain or as a branched  
10                        chain, or a phenyl group or a benzyl group and X= a halogen, an alkoxy, aryloxy or benzyloxy as  
11                        defined above #(2). Another common example is dichlorodiphenyl- silane.

12                         (2) Chlorotrimethylsilane represented by the general formula [R]<sub>3</sub> Si-X, where R is an  
13                         alkyl group ranging in carbon chain length of 1 - 20 units as a straight chain or a branched chain  
14                         and X which is a halogen an alkoxy, aryloxy or benzyloxy as designed above. Another common  
15                         example is Chlorotriphenylsilane.

16                         (3) Hexamethydisilazane: This compound will form a trimethylsilyl derivative of the  
17                         hydroxyl groups of the components of wood or wood products with the evolution of nitrogen in  
18                         combination with an appropriate catalyst. The catalyst may be phosphoric acid that by itself may  
19                         render the wood fire resistant

20                         (4) Octyltriethoxysilane [OTS]. This is an excellent reagent that would function in neutral  
21                         environment. The drawback is the high boiling point [difficulty drying] and slow reaction (more  
22                         than a week after treatment). The reaction may continue. A significant waiting period may be

1 required to complete the process. The reagent is cost-effective and environmentally clean.  
2 Possible improvements to speed up the reaction with the addition of catalysts [metaphosphoric acid]  
3 that could also render fire proofing remains attractive. Another common example is  
4 Propyltriethoxysilane.

## 5 **Phosphorous Reagents**

6 Phosphorous reagents can also be used to modify the hydroxyl groups of wood  
7 components to make the wood fire and insect resistant. Common reagents that can be used for  
8 this purpose are:

9 (1) Triethylphosphate: Here phosphorous is in the pentavalent state and the trimethoxy  
10 groups are prone to hydrolysis by moisture/water within the wood and generate phosphoric acid  
11 or polyphosphoric acid which is a fire retardant. The hydroxyl groups of the cellulose or other  
12 wood components may directly react with Triethylphosphate displacing one or more of the  
13 methoxy groups with the formation of a chemical bond between the phosphorous and the oxygen  
14 atoms of one or more of the hydroxyl groups. Another common example is Trimethylphosphate.

15 Triethylphosphite: Here phosphorous is in the trivalent state as in trimethylborate [TMB]  
16 and the mechanism of reaction with wood or wood components are identical to those of TMB as  
17 described above. As is the case with TMB there are two possibilities. Triethylphosphite can react  
18 with moisture (water) in the wood or wood components to produce phosphorous acid or  
19 polyphosphorous acid within the wood to make it fire and insect resistant. When used in  
20 combination with a silicon reagent this combination would trap the phosphorous acid trapped .  
21 Alternately triethylphosphite can react with one or more hydroxyl groups of wood cellulose or  
22 other components of wood to form permanent chemical bonds to render wood fire and insect

1 resistant. Other common reagents are Trimethylphosphite or Triphenylphosphite.

2 No chemical process necessarily results in a single outcome. Figure 6-b shows an  
3 approximation of the most likely end structure for cellulose without a complete replacement of  
4 hydroxyl atoms in the chain when treated with a mixture of silicon and boron under the process  
5 steps taught hereunder.

6 Figure 6a shows a less likely structural outcome which is improbable and is given more for  
7 purposes of disclosing all manner of potentially allowable structures as opposed to the structure  
8 considered a likely end product.

9 Figure 8 shows the reaction postulated for a boron donor. The corrugated double line 1  
10 represents the cellulose polymer while the cellulose OH groups are non-remarkable, hydroxyl  
11 groups coming off from individual cellulose molecules within the polymer as a result of the  
12 reaction

13 Figure 8 shows where  $B(OCH_3)_3$  (A) is converted to an intermediary  $B(OH)_3$  (B) which  
14 then reacts with the hydroxyl groups (C) to yield a polymer of Boron and Cellulose polymer.

15 Figure 8 B1 and B2 show alternative intermediary boron molecules which may be utilized  
16 in this process.

17 As can be seen by reference to Figure 13, the process of treating wood may be described  
18 as introducing a wood product 3 into a chamber 12 which opens at entry 9. The entry 9 is then  
19 closed and if desired an electromagnet field is introduced to expedite the reaction using field  
20 generators 11 which may be magnets or ultrasound generators to obtain desired atomic alignment  
21 to enhance or restrict the reaction

22 In the preferred embodiment ultrasound is used to align and open the partial passages of

1 the wood to enhance penetration.

2 This field may be maintained by the process or it may be begun and stopped repeatedly or  
3 terminated after a certain time to get the desired penetration or to limit the treatment area to the  
4 surface of the wood by closing the natural wood passages. At this time or before one or more  
5 reactants may be introduced into the chamber 12. Thereafter the entry 9 is closed. The reactants  
6 or removing reactants are introduced through a chemical opening 4 in the container which may  
7 be sealed by a valve 7. The valve (or otherwise) may include a temperature or pressure monitor  
8 to determine when the reaction is complete or when it has reached a certain level. The chamber  
9 may be vented.

10 At any point the reagents may be drained through a valve in a drain 5 and other chemicals,  
11 such as acid neutralizing agent may be added to wash or treat the wood.

12 Thereafter the wood my be removed from the entry 9 or an appropriate exit 10 so that one  
13 piece of wood may be used to push the other out in an automated process.

14 Figure 14 show how particles of wood 13 may be turned into particle board utilizing the  
15 process through the steps of combining the particles 13 with a glue 14 and one of the reagents  
16 (such as borax) in a chamber 18 in the bottom 19 of a press. Before, after and during the  
17 compression process when the top 17 of the pump presses on the mixture of glue, wood and  
18 reagent, a solvent 16 may be introduced through a passage 70 in the chamber to initiate the  
19 reaction. A pressure release valve 21 may be used to allow gases and pressure to escape this  
20 process.

21 The process of locking in beneficial atoms or molecules within the wood structure  
22 comprises the steps of:

1           (1) Selecting an additive which may enhance a desired property from the group of  
2           properties comprising:

3           (a) Fire resistant,

4           (b) Insect resistant,

5           (c) Moisture resistant,

6           (d) Modified by color or stain,

7           (e) having better glue attachment qualities,

8           (f) having better insulation qualities, and

9           (g) to change the chemical structure of cellulose or some other chemical within the wood  
10          to change specific characteristics to the wood.

11          (2) Adding the additive to the wood:

12          (a) mixing particles of wood with the additives and forming a wood composite;

13          (b) dissolving the additive and flowing the additive into the wood or;

14          (c) pressing the additive with the wood in a gas or solid phase;

15          (d) reformulating the wood cellulose polymer to create a partial or full barrier to  
16          leaching.

17          An added step would be to enhance absorption of the additive or reformulating chemicals

18          using (i) alignment and /or opening of wood pores using ultrasound, electromagnetic fields, heat,

19          heat with steam and the like.

20          Because many varying and different embodiments may be made within the scope of the  
21          inventive concept herein taught and because many modifications may be made in the  
22          embodiment(s) herein detailed in accordance with the descriptive requirements of the law, it is

- 1 to be understood that the details herein are to be interpreted as illustrative and not in a limiting  
2 sense.